

Chapter 5

Death of the Watchmaker: Modern Science and the Providence of God¹

Arnold E. Sikkema

Let me begin by quoting John Polkinghorne, theoretical physicist and Anglican priest, as he addresses the nature of this presentation. “Interdisciplinary work is both essential (for, in the end, knowledge is one) and risky (for we must all venture to speak on topics of which we are not wholly the master).”² A key phrase affirmed by Reformational thinking which upholds a high view of creation is that “knowledge is one”; we believe that “in [Christ] *all things* hold together” (Col 1:17). I had the pleasure of spending five weeks in the summer of 1998 at Calvin College with Polkinghorne and a dozen other physicists, philosophers, and theologians, and much of what I have to say tonight is influenced by that experience.

The doctrine of the providence of God is one of the most cherished truths of Christianity. Article 13 of the Belgic Confession (1561) states that God, having created all things, does not forsake them, but rules and governs them. Chapter V of the Westminster Confession (1648) goes on to say that he uses “means” to “govern all creatures, actions, and

¹ This paper was made possible in part through support of The Pew Charitable Trusts and the Seminars in Christian Scholarship program at Calvin College.

² John C. Polkinghorne, *Belief in God in an Age of Science* (New Haven: Yale University Press, 1998), p. 83.

things.” In this presentation, I wish to explore what modern science has to offer to flesh out an understanding of the means by which God rules and governs his creation.

In the centuries before what is commonly called the scientific revolution, the working of the world was seen as essentially deeply spiritual. Those who believed in God trusted that it was his hand that made things happen. They would say he ends the night by bringing sunshine in the morning, sends rain for the fields, brings babies to birth. And we who believe in God have this same trust. While labelling that time period as the Dark Ages gives the impression that processes were seen as entirely mysterious or random, there was clear understanding of cause and effect. If a large dark cloud approached, everyone knew it might very well rain. God sent the rain *by* dispatching the cloud. God uses means to provide for his creation, and to provide for his people.

The scientific revolution brought more detail and sophistication to our understanding of the way in which God uses means. Rain comes because water vapour condenses when it cools and the droplets get too large to remain suspended. But it is God who condenses the water vapour and who puts tiny droplets together to make larger ones.

Newton: Dualism Overturned

Foundational to this scientific revolution in physics were ideas formulated by Galileo Galilei (1564-1642) and Johannes Kepler (1571-1630) at the turn of the sixteenth century. They developed the mathematical description of the motion of balls rolling down inclined planes as well as of planetary motion. Born in the year Galileo died, Isaac Newton (1642-1727) completed their program by providing a very general and accurate description of motion in terms of the forces involved. One of the most important (and shocking!) things Newton did was to shatter a strong Greek dualism which had been incorporated into Christian philosophy by Thomas Aquinas (1225-1274) and the scholastics several centuries before. Scholastic physics represented a three-way synthesis of Aristotle's (384-322 BC) beliefs about the nature of things, Christian doctrine, and astronomy. It taught that here on the earth, everything was composed of a mixture of four basic substances: earth, water, air, and fire. Motion is mainly due to the tendency of things to separate into the four substances, with each substance proceeding to its so-called natural place. Ideally, earth (solids) would be at the centre of the universe; next there would be a layer of water; then the air; and

finally fire reaching up to the heavens. The churning of the heavens above kept things from reaching this ideal state. So, heavy things, such as rocks and apples, fall down because they are made of earth. Smoke is made of fire and air which tends to rise toward the heavens. In the perfection of the heavens, sun and moon, planets and stars, were made of a fifth essence, *quintessence*, entirely different in nature from things on earth. These inhabitants of the heavenly realm move with perfection among the crystal spheres.

But Newton, over against this Aristotelian dualism, demonstrated that the motion of the moon around the earth and the motion of an apple falling off a tree have exactly the same cause: gravity. It is just a matter of scale: an apple falls five metres from rest in one second, the moon one and one third millimetres. Most of us will have been faced with Newton's three laws of motion and his law of universal gravitation in high school or university. Since these laws can be expressed mathematically, you can accurately predict the time it will take for a ball to roll down an inclined plane if you know the angle and length of the slope. You can figure out how much longer to make the pendulum of a grandfather clock to make it tick off one second less in a day. And we've used Newtonian mechanics to put a man on the moon. All of this works because if you know what forces are acting on an object (like a ball, a pendulum bob, a rocket), you can predict its resulting motion, and this works with remarkable precision.

Newton, being a believer in God, was concerned that his understanding of the universe seemed too mechanistic. So he found four ways to fit God into this world operating as a machine. (1) God is the one who designed it intelligently. (2) His omnipresence and eternity are what give expression to the infinite space and time of the cosmos. (3) He is the one who provides action at a distance (like the force of gravity between earth and moon). And (4) he intervenes from time to time to stabilize processes. This last idea, the stabilization of processes, Newton thought was necessary to understand planetary motion. While a single planet orbiting around the sun is quite straightforward to analyse, things get complicated when there are several planets, each affecting the other. Newton thought the resulting irregularities could eventually magnify and destabilize the entire solar system; God had to do the job of making minor adjustments directly when necessary. But within two generations, Pierre Simon de Laplace (1749-1827) showed that the orbits' irregularities are actually self-correcting — so God is no longer needed for that. All God

was required for was to design the watch and wind it up. The idea was that, once started, the subsequent motion of all the little bits of the world would be fully determined. The world is a machine, a nicely ticking watch. While Newton would not necessarily have approved, this Newtonian mechanical worldview with God as the watchmaker became firmly embedded in culture.

Newtonianism: Dualism Re-established

So firmly embedded, in fact, that the majority of Christians also believe it, and many have, perhaps unwittingly, adopted it into their framework of Christian beliefs. However, this is not simply a typical Christianization of secular philosophy, such as was completed by Thomas Aquinas's assimilation of Aristotelianism into Christianity. Newtonian mechanistic beliefs in large part originated in the Christian belief that the faithfulness of the Creator should be evident in the process of the world. Then they were secularized as the "necessity of God" was removed. And finally Newtonian beliefs were re-Christianized into the notion of God operating in the world simply by maintaining the laws which govern the processes in the world. Christians take the liberty of including occasional miracles in which God temporarily acts differently from the way he regularly does. But for the most part, things carry on as they should. After all, the individual particles that make up the universe, including those at the smallest level, are simply bouncing off each other in ways easily understood and in principle fully predictable.

So, summarizing the Christianized view of the "Newtonian world as machine" idea, God acts in the world in two ways: the regular way (maintaining the laws) and via miracles. Given this, what do we expect when we offer prayers to God, particularly petitionary prayers? I don't take seriously the idea that we pray *simply* because God wants us to; I think Scripture describes prayer as being genuine communication. Suppose we hold a Christianized Newtonian understanding of the universe as being, for the most part, a deterministic mechanism. Consequently, *either* we express the desire, hope, or wish that things have already been set up to proceed in the direction we are asking, *or* that God will intervene and go against the regular laws he has instituted. It is this dualistic understanding that I think needs to be corrected, and it seems to me that modern physics can be instructive to this end. For the Christianization of Newtonian ideas must be tempered by the fact that Newton's laws have seen substantial revision in this century. In fact, the

notion of God as watchmaker has been dealt a fatal blow by twentieth-century discoveries in physics. If God is a watchmaker, then he is dead.

Modern Physics: What's an Electron?

Two things killed the watchmaker picture: quantum mechanics and chaos theory. Quantum mechanics says that, for example, it is intrinsically impossible to say when a particular atom is going to undergo radioactive decay. For when we consider the smallest processes, it is fundamentally impossible to make specific predictions apart from statistical ones. And chaos theory says that we cannot make even very general predictions about large-scale systems (such as the air in a room, or the entire atmosphere) without having literally universal knowledge. For example, in what is known as *the butterfly effect*, the precise way a butterfly flapped its wings in Tokyo in early September may have been what made Hurricane Mitch pound Central America in late October instead of fizzling at sea. There are currently a number of scientists and theologians working on using the openness afforded by quantum mechanics and chaos to approach a cohesive understanding of how God acts in the world in such a way as to both truly answer prayer and be fully faithful to his covenant with creation. John Polkinghorne, for example, believes that the way God works in the world is by using universal knowledge to direct “active information” in a top-down holistic way.

What does all this have to do with the development of a Reformational world- and life-view? In addition to informing our approach to petitionary prayer, there is a particularly interesting idea about the lawfulness of creation that modern physics proffers. A Reformational worldview understands creation to be governed by God by means of laws, or norms. All things owe their existence directly to God, and all things function in reference to laws governing the various aspects of existence. God gives creation inherent laws which allow sense to be made of things and meaning to be attached to things. This structure—God, law, thing—seems to require three parts: (1) *God* institutes a set of (2) *laws* to govern each (3) *thing*.

But what is a *thing*? I believe that modern physics tells us that thing-ness must be defined very carefully. Earlier I mentioned that quantum mechanics has implications for the very small. I don't mean the size of a dust particle, but the sizes of atoms, nuclei, protons, electrons. But what is an electron? Ignoring the wave/particle question, the usual

answer is that an electron is an entity with a certain mass, charge, spin, etc. Each of these properties of the electron is responsible for its reaction to the relevant type of environmental disturbance, such as applied force or gravitational field, electric field, magnetic field, etc. So an electron is an object which is subject to certain laws, just like every other object in the universe. But modern physics, in particular quantum field theory, reveals that this picture is far too naive. For even in the absence of any kind of external influence, all of these electron's properties are at play. We have discovered that the electron is far from being a bit of matter subject to certain laws: no quiet little electron sitting there waiting for something to react to, no simple objective existence here. Instead, what we call an electron is actually an extremely complicated "mess" of astonishingly rapid emission and reabsorption of photons (particles of light), and of every other sort of particle in fact! (See figure.)

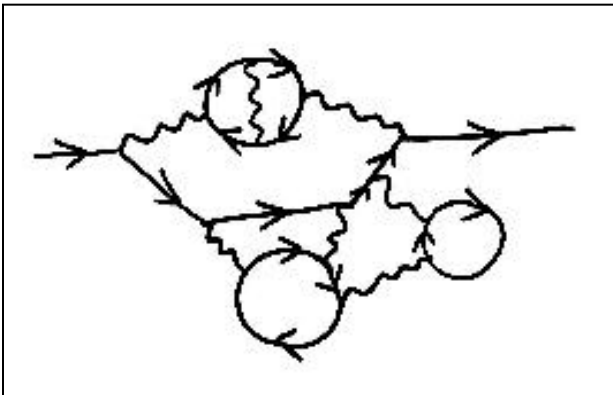


Figure 1: a Feynman diagram indicating a set of possible ways in which an electron (solid lines with arrows) is a seething mass of emission and reabsorptions of virtual photons (wavy lines).

And each thing that is emitted and absorbed is itself a seething mass of emission and reabsorption, a bit like fractal images. But each emission and reabsorption demonstrates intricate concern for detail with regard to very general conservation principles. So there is never actually just a "thing" which we call an electron sitting there, for its lawfulness is built inextricably into its thingness.

Let there be...

I believe this is an example of a more general principle. God doesn't just create things and then institute laws to govern them. He gives them being, building lawfulness inextricably into thingness. This may be understood with reference to God's recurring command in Genesis 1, "Let there be." God isn't just saying, "Make light," and then proceeding to govern it once made; no, he *allows light to have an existence*. And part of this existence is that light goes ahead and behaves like light does,

especially in its quantum field theoretical sense of being a seething and indeterminate mass of particle creation, annihilation, emission, and absorption. God could make light do whatever he wants it to do, but he has *let it be* light; therefore he chooses to restrict his operation in the universe in a manner which is consistent with his allowing it to be.

This does not mean that I am suggesting that light, or anything else for that matter, can have any properties in and of itself. All created things depend for their continued existence directly upon the Creator as much as they do for their original (created) existence. I am, however, suggesting that light, and indeed all things, actually have properties: properties which affect their behaviour. The having of properties is entailed by God's "Let there be" imperative, and is not merely illusory. Things having properties is what makes cause and effect real in the universe.

Cause and Effect: Illusion or Real?

But is cause-and-effect real? Consider what happens when a video game is being played on a TV screen. You see balls getting hit by bats, but what's really happening is that the electrons being shot from the back of the TV tube are turned on and off in complicated patterns as they sweep over the screen, so that images are formed. An image of a ball traveling to the left getting hit by the image of a bat traveling to the right cannot actually make the image of the ball end up traveling to the right! What we think of as cause-and-effect (the bat hitting the ball) is purely contained within the programming—none of it resides on the screen. The notion of cause-and-effect we see on the screen is merely an illusion, and must be credited to the program. So it is in the universe, says Donald MacKay, a Scottish theologian writing about God and science.³ He believes the sovereignty of God requires that God arranged the world so that it has the *appearance* of cause and effect. A universe which was completely unpredictable (*e.g.*, in which releasing a ball in the air would not be followed by the ball falling down), would be one with no apparent cause and effect, and certainly would be displaying a different kind of a god. The fact that it appears to have cause and effect is a reflection of God's goodness and omniscience, his power and wisdom, and reveals a God who is concerned about and for his creation and especially his human creatures.

³ Donald M. MacKay, *Science, Chance, and Providence* (Oxford: Oxford University Press, 1978), pp. 18ff.

While I affirm some of what MacKay says about God being revealed in the way things happen, I would contend that a Reformational worldview takes creation much more seriously than his video game analogy does. God has actually endowed his creation with cause and effect relationships as part of the divine fiat “Let there be.” While agreeing with MacKay’s assertions about the video game itself, I am sure that a bat hitting a ball actually does something – of course not outside of the purview of God’s sovereignty, but God has given bats and balls the properties they and their fundamental constituents have, so that when bat impacts ball, the bat and ball are actually interacting. Properties are not mere illusions. A world with no real cause and effect is a world in which there are no real properties and is therefore in effect a world in which no “Let there be” has been spoken and is not the world whose creation is depicted in Genesis 1.

The reader may have noticed that I have been using the word “real” a few times in the last few paragraphs. What is the alternative to “real”? And why insist on reality? Talking about things like properties and interactions being real is an aspect of realism, the philosophy of science which most physicists operate under but few philosophers hold. Basic to realism is its insistence that “what we can know ... is a reliable guide to what is the case.”⁴ The development of scientific theories, being rooted in the real world, is an approach to an understanding of the way the world *is*, not just the way the world *appears*. God, having created us in his image, equips us to fulfill the creational cultural mandate, so we may be confident that the world has an underlying existence which we are able to some extent to grasp.

Revelation: Covenant Faithfulness

Now, we do not have to rely solely on our scientific expertise, or even our experience with the world, to figure things out. God has also revealed in Scripture some important aspects of the way he works in and with the world. Foundational is God’s covenantal relationship with his creation. In Genesis 8:22 we read, “As long as the earth endures, / seedtime and harvest, / cold and heat, / summer and winter, / day and night / will never cease.” The fact that the daily and seasonal cycles continue is a direct result of God’s covenant faithfulness. God has made a commitment to us and to his creation that this will be so until the earth

⁴ John Polkinghorne, *Faith of a Physicist* (Princeton: Princeton University Press, 1994), p. 156.

remains no more. Every person who sets his alarm clock affirms and expects God's covenant faithfulness, whether he acknowledges it or not. For there is no other way that we can know for certain that the sun will not suddenly rise in the west at midnight. One of my worst nightmares was a dream in which the sun and moon were bouncing off the horizon; it wasn't until I saw the Genesis 8:22 connection between God's covenant faithfulness and the cycle of morning and evening that I realized the true depth of horror I was experiencing.

There are other indications in Scripture that God governs the physical aspect of his creation by means of law. In Job 38:33, God asks Job if he knows the "ordinances of the heavens, [o]r fix[es] their rule over the earth." Psalm 148:6 says, "He set them in place [things in creation] for ever and ever; he gave a decree that will never pass away." Jeremiah 31:36: "Only if these decrees [of sun, moon, stars, and sea] vanish from my sight," / declares the LORD, / "will the descendents of Israel ever cease / to be a nation before Me." Jeremiah 33:20-26 repeatedly emphasizes covenantal language: "This is what the LORD says; 'If you can break my covenant with the day and my covenant with the night, so that day and night no longer come at their appointed time, then my covenant with David my servant ... can be broken and David will no longer have a descendant to reign on his throne.' ... This is what the LORD says, 'If I have not established my covenant with day and night and the fixed laws of heaven and earth, then I will reject the descendants of Jacob and David my servant and will not choose one of his sons to rule over the descendants of Abraham, Isaac and Jacob. For I will restore their fortunes and have compassion on them'"

To summarize what these and other passages teach, God's laws (also called ordinances, rules, boundaries, decrees) for the physical aspect of creation are normative and covenantal, but these are incompletely knowable by man; they serve not only to regulate the creation, but also to reveal to humanity God's character, faithfulness, omnipotence, omniscience, wisdom.

Eighteenth-century philosopher David Hume claims there is no logical way that *we* can figure out laws concerning future events strictly from regularities observed in the past. Hume is in effect affirming God's humbling of Job when he asked, "Do you know the ordinances of the heavens?" But does that mean that science has no hope of figuring anything out, or that when we do, it only relates to our perception and not to the way things really are? This problem is never satisfactorily

addressed by unbelieving scientists, but Christians (and Jews) have reason to believe the possibility of discovering laws: a grounded belief that reality is lawful together with faith in God who in his covenant faithfulness maintains his laws.

A Caveat

God governs the behavior of the universe via laws of which we can at best hope to attain partial understanding. And while it is true that because God is faithful to his creation, and that he faithfully maintains his laws, we must be careful not to tie faithfulness too closely to our *limited* and *current* understandings of regularity. To be sure, God has revealed that certain regularities can be absolutely depended upon in connection with his covenant faithfulness, namely those of days and seasons (Gen 8:22; Ps 74:17; Jer 33:20). But going beyond this one must avoid any absolute certainty that it is God's establishment of regularity we are dealing with. For example, we now recognize that expecting the interior angles of a triangle to always add up to 180° (or, equivalently, that $a^2 + b^2 = c^2$ in a right-angled triangle) because of God's faithfulness fails when considering the real world. The so-called fact that a triangle's angles add up to 180° is only *precisely* true in the abstract: in Euclidean geometry. Experience and observation show that this is only *approximately* true (indeed, to a *very* high degree of precision). The real world is not exactly Euclidean; measurements show that the sum of the angles is actually always ever-so-slightly greater than 180° . The amount by which it is greater depends on the area of the triangle and the strength of the gravitational field in its interior! This is just one example indicating that, in general, currently perceived regularities are only approximate and potentially subject to more accurate description. We must be very careful to give credit to God's faithfulness and dependability for our current understanding of regularity, for this understanding is limited and subject to revision.

God's faithfulness allows for the intelligibility of the universe. We can rely on this to come to a greater appreciation of and insight into the regularities of the world. It is within the context of these regularities that we work and develop fruitful theoretical understanding. To do this, a scientist must either trust in God's faithfulness, or believe that there is some other self-existing governing entity.

The Governor of the Universe

The scientific enterprise is, of course, engaged in an effort to understand the world in terms of scientific laws. Steven Weinberg, a Nobel prize-winning theoretical physicist, talks about the discovery that “nature is strictly governed by impersonal mathematical laws.”⁵ You may notice the metaphysical assertions contained in every single word of that claim, and that this understanding is a discovery. Fortunately he is considered extreme in his position, even among unbelieving scientists. Physicists generally believe there is some set of fundamental laws which in some sense *govern* what happens, and that our laws of physics are mathematical expressions which *describe* what happens. There seems to be good reason to believe that, in the course of scientific advance, the descriptive laws of physics are improving as approximations to the fundamental governing laws with greater degrees of accuracy. Few physicists actually think that Einstein’s gravitational theory, general relativity, is *responsible* for keeping the solar system from flying apart, although it is an undeniable fact that such language is very commonly employed or approved of, especially in teaching, popular writing, and the media. General relativity is only a theoretical description of a deeper, more mysterious, *working* of the universe. Theories and principles simply cannot govern. The physicist believes that something underlies these laws and is able to govern, and the theist identifies that with God (although he is much more than that), even if a so-called “theory of everything” is found.

It is our God who governs the universe in his providence. He has created all things, endowing them with real properties. He continually upholds these properties in his covenant faithfulness and allows these properties to contribute to the course of events in a true cause-and-effect manner. One of the characteristics of physical processes is their openness to future development in ways which are not determined by their present state. God, having truly *let* these properties *be*, continually works within the created structure to direct the course of events to the fulfillment of his plan, retaining the integrity of the created order. But there is more to reality than simply the physical. There is life, there is human consciousness, there is art, there is faith. How God works within the context of the human will is far less scientifically understood.

⁵ NYRB, 8 August 1996, 12, 15.

Adam and Eve were created in the image of God. After their rebellion, God in his mercy promised to provide a Redeemer. Through the course of the Old Testament, we see how God focused his plan on the people of Israel, by whom all nations would be blessed. Luke 2 shows how detailed that plan was, involving what would at first appear to be insignificant details. It all comes together in Jesus Christ, born in Bethlehem, and it all proceeds from him in the propagation of the gospel.⁶ He is Lord of all. In him *all things* hold together. To God alone be all praise and all glory.

⁶ Editorial comment: this LambLight Lecture was presented just before Christmas, 1998.